

Dennis Ocholla · Omwoyo Bosire Onyancha ·
Aderonke Olaitan Adesina *Editors*

Information, Knowledge, and Technology for Teaching and Research in Africa

Human Machine Interaction and User Interfaces

Synthesis Lectures on Information Concepts, Retrieval, and Services

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Interfaces

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Foreword

In the dynamic and ever-changing landscape of data, information, knowledge, and technology, the African continent stands at the threshold of innovation, adaptation, and profound transformation. The journey through this evolving landscape is captured eloquently within the pages of *“Information, Knowledge, and Technology for Teaching and Research in Africa: Human Machine Interaction and User Interfaces.”* This seminal book, a collaborative effort between highly esteemed African scholars, not only illuminates the intricate interplay between humans and machine but also underscores the pivotal role of user interfaces in shaping information-seeking, retrieval, and use to meet human needs.

The golden thread that runs through this book is the recognition of human–machine/computer interaction as an increasingly critical aspect of our professional careers, propelled by the profound impact of the fourth industrial revolution. From reading the book, it has become clear that not only new challenges but also possibilities, are created by technologies such as artificial intelligence. Within this context, the methodologies for development and implementation of human–machine interfaces are more than ever subject to critical analysis, demanding innovative approaches to enable the maximization of possibilities that these technologies offer in support of information retrieval and decision-making in different domains.

Authored by leading and upcoming African scholars, this volume transcends geographical boundaries, offering insights with global resonance, while, on the other hand, maintaining a steadfast focus on the African context and experience. This is in my opinion the real strength and uniqueness offered by this work. Through a meticulous examination of a variety of interrelated topics, each of the eight chapters contributes to a rich tapestry of knowledge that promises to enrich the collective space of the academic discourse and at the same time inform practical endeavors. From the theory of diffusion of innovations to the convergence of library and information science and digital humanities, and from the evaluation of e-school initiatives to the exploration of health informatics and the use of modern technologies in support of the transfer of indigenous knowledge, the breadth and depth of this textbook is truly remarkable.

Chapter one, penned by Blessing Mbatha, delves into the theory of diffusion of innovations, shedding light on the intricate process of adopting new technologies within the

African context. Mbatha's exposition not only elucidates the theoretical underpinnings but also underscores its relevance to the field of library and information science. Joseph Kiplang'at and Humphrey Keah, in chapter two, navigate the convergence of digital humanities with library and information science (LIS), offering critical insights into the status and potential of this interdisciplinary domain with LIS schools in African universities. Their recommendations provide invaluable knowledge for further development of digital humanities in LIS schools in Africa. In chapter three, Hesbon Nyagowa evaluates the NEPAD e-school pilot in Kenya, employing a rigorous framework to derive invaluable lessons for the future of e-learning initiatives in Kenya. Kehinde Owolabi, in chapter four, confronts the challenges of clinical informatics adopting in academic hospitals, advocating for its transformative potential in mitigating medical errors and improving health care within the African context. Ese Ovwasa, in chapter five, advocates for the indispensable role of nursing informatics in healthcare, emphasizing the need for a holistic approach to nursing practice in Africa and beyond. In chapter six Mercy Nkanata scrutinizes the effectiveness and efficiencies of e-Governance initiatives, offering a comprehensive assessment within the African context and proposing strategies for sustainable service delivery. Rexwhite Enakrire, in chapter seven, explores the utilization of information and communication technologies by libraries in academic institutions, charting a path towards harnessing technology for improved management in academic libraries. Petros Dlamini, in the last chapter, embarks on a literature review journey to unravel the dynamics of acquiring and transferring of tacit indigenous knowledge, shedding light on the intricate processes that underpin knowledge creation and dissemination in Africa.

A word to the editors: Professors Dennis Ocholla, Bosire Onyancha, and Dr. Aderonke Adesina, you have curated a collection that not only embodies academic rigor but also articulates a commitment to advocating scholarly discourse within Africa and beyond. This momentous work serves as a beacon of knowledge, that will guide students, professors, practitioners as well as enthusiasts alike around the world on a transformative journey through the realms of information, knowledge, and technology within the African context.

It needs to be stated in conclusion that this book stands as a testimony to the vibrancy and rigor of African scholarship and its profound impact on the global academic stage. It is my fervent hope that this volume will serve as a catalyst for further discourse, discovery, and global collaboration enriching thereby the academic landscape and empowering the future generations to successfully adapt to and navigate the complexities of ever-changing technologies.

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Preface

We argue that Human Machine Interaction and User Interfaces is increasing and becoming a common phenomenon of information seeking, retrieval, and services that cannot be ignored. The foregoing has been associated with computer and society, informatics, social informatics, information, and communication technology for development (ICT4D) and most recently with the fourth industrial revolution technologies such as Internet of things and artificial intelligence. Information seeking, retrieval, and services space is currently filled with several technology-driven user interfaces which is continuously challenging information access and success thereby demanding urgent response in several ways. Research and evaluation of information systems, services, and usage must be intensified to develop and improve the user interfaces for human benefit.

The book consists of eight chapters. The first chapter is entitled “[Diffusion of Innovations: How Adoption of New Technology Spreads in Society](#)” In the chapter, Blessing explores and explicates what the Diffusion of Innovations Theory is about, the characteristics of innovators, the five-step process that an individual goes through when adopting a new idea or product, five adopter categories, the relevance of the theory to the LIS field, and concludes with the criticism of the theory. The chapter also argues that the Diffusion of Innovations theory is relevant to the LIS field, which has widely adopted numerous innovations to automate a wide range of administrative and technical processes, build databases and networks, and provide better services to library users. The diffusion and adoption of technology have become imperative for the efficient management of modern libraries and LIS as a field in general. The second chapter on digital humanities, entitled “[Convergence of Library and Information Science and Digital Humanities: A Case of Selected Universities in sub-Saharan Africa](#),” is written by Joseph Kiplang’at Humphrey Keah from Africa International University and Rightpoint information services, Kenya, respectively. The two authors recognize the importance of Digital Humanities (DH), note its limited growth, and examine the status of digital humanities in LIS Schools in selected universities in Africa by focusing on the theoretical and historical development of DH in the context of LIS education and how infrastructure influence DH programs/initiatives in respective LIS schools. The study findings and recommendations provide

valuable knowledge for developing the domain and establishing potential areas of collaboration in DH research and curriculum. The third chapter, written by Hesbon Nyagowa from the Technical University of Kenya, is entitled “[Evaluation of NEPAD E-School Pilot in Kenya](#)”. The study set out to evaluate the success of the e-school system using an adaptation of DeLone and McLean’s 1992 information system success evaluation model. The study revealed that six dimensions of e-school contributed to its success but failed to confirm user satisfaction as a seventh dimension. The study recommended a tracer study of the graduates of the e-school to understand further the effect of those schools on their adjustments to post-secondary school performance. The fourth chapter, entitled “[Clinical Informatics Adoption, Use and Challenges Among Doctors in Teaching Hospitals](#),” is written by Kehinde Owolabi from the Federal University of Agriculture, Nigeria. The chapter reviews existing literature that is related to the adoption, use, and challenges facing the development of clinical informatics in teaching hospitals in developing countries. The study reported literature on the meaning of clinical informatics and types; the study used the Unified Theory of Acceptance and Use of Technology to explain technology adoption. Various benefits and challenges facing the adoption of the technology were also reviewed. The chapter explains the dangers of medical errors and how clinical informatics tools can reduce medical errors, increase access to safe, effective, and affordable treatment of illnesses, and promote evidence-based medicine. It reveals that hospitals in developing countries should embrace the use of tools for effective healthcare delivery. In the fifth chapter entitled “[Nursing Informatics in Health Care. A Global View](#),” Ese Owasa, Diodemise from Delta State University Nigeria acknowledges that Nursing informatics is very significant in nursing practice and reviews global literature scoping evaluation on the benefits of NI integration and adoption in healthcare. The major features of nursing informatics implementation were evaluated in critically examining developing technologies such as healthcare promotion, advanced systems, improved medical mistakes, and saving time. Given the nature and evolution of the information age, all kinds of nurses must get the requisite IT (Information Technology) training. The sixth chapter in this section, entitled “[Evaluating Huduma Centres E-government Initiatives for Sustainable Delivery of Services in Public Organizations](#),” is written by Mercy Gacheri Nkanata from the University of Zululand, South Africa. Mercy argues that. Due to the forces of globalization, effective and efficient public service delivery has become one of the main justifications for the existence of any government. The chapter reviews the literature on the suitability of DeLone and McLean’s IS success model in evaluating e-government systems. The model’s six dimensions of suitability in e-government assessment are analyzed, and the application challenges are discussed. The seventh Chapter, “[The Use of Information and Communication Technologies \(ICTs\) by Librarians for Information and Knowledge Management in Academic Institutions in the Fourth Industrial Revolution](#),” is written by Rexwhite Tega Enakrire from the University of South Africa. The chapter recognizes the role of academic institutions and the use of information and communication technologies (ICTs) by librarians for information and knowledge (IKM) in such institutions in the Fourth

Industrial Revolution (4IR). The chapter examined the types of ICTs used by librarians for IKM in academic institutions, determined the role of librarians in using ICTs for IKM in academic institutions, and explored strategies to improve the use of ICTs by librarians for IKM in academic institutions. The author notes the rapid shift in the role of librarians in academic institutions and the catalyst factor of ICTs. Rexwhite recommends proactive support by the management of academic institutions to librarians for better and quality service delivery in the Fourth Industrial Revolution. In the last chapter entitled, “[Acquiring and Transferring of Indigenous Knowledge Among Its Owners: A Literature Review](#)”, Petros Dlamini, from the University of Zululand, presents a survey of literature on acquiring and transferring of indigenous knowledge among its owners focusing on the type(s), methods, and challenges of acquiring and transferring indigenous knowledge among its owners. The chapter is informed by knowledge creation models which supports promotion and transferring of tacit knowledge like indigenous knowledge. The chapter acknowledges the marginalization of indigenous knowledge and recommends that there is a need for Africa to develop and accelerate strategies for enhancing indigenous knowledge for future generation and ICT is poised to play a crucial role.

All chapters have been blind peer reviewed by at least two reviewers of good academic standing from Africa and their valuable recommendations duly incorporated to improve the quality of the chapters. We thank the reviewers for their time and valuable input for the quality control of the book. We also thank the contributors to this book for their quality chapters and for enabling knowledge sharing globally. We strongly believe the book will be valuable for university-level teaching and research in Africa, and perhaps elsewhere, where such knowledge would be valuable for comparative studies.

Richards Bay, South Africa
Pretoria, South Africa
Richards Bay, South Africa

Dennis Ocholla
Omwoyo Bosire Onyancha
Aderonke Olaitan Adesina

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About the Editors

Dennis Ocholla Ph.D., graduated with a Ph.D. in Library and Information Science in Kiev and Saint Petersburg/Leningrad in the former USSR in 1988. He is currently a Research Fellow at UNIZULU after retirement as a Senior Professor at the university in 2022. He joined the University of Zululand as Professor (FP) and Head of the Department of Library and Information Science (1996–2014) and was appointed Senior Professor at the University in 2006. He started his academic career at Moi University in Kenya, as a lecturer in 1988 and later Senior Lecturer and Head of the Department of Library and Information Studies before moving to the University of Botswana as a Visiting Scholar (1995–1996). He has served the University of Zululand as Dean (1998–1999), Vice Dean (2007–2011), and Deputy Dean of Research and Internationalization (2014–2019), in the Faculty of Arts (now Humanities and Social Sciences). His research and teaching interest—where he has published and graduated with many masters and Ph.D.s—include—information seeking, KM and IKS, ICT4D/Human computer interaction-user interfaces, LISE, data science—bibliometric/informetrics, information practices-information seeking, information ethics, scholarly communication, and research methods. He serves/has served in the editorial and peer review boards of many local (RSA) (e.g., SAJLIS) and international journals (e.g., Library Management, Informetrics, LIBRI), conferences, and research organizations/councils. He was the Editor-in-Chief of *Inkanyiso: Journal of Humanities and Social Sciences* (2009–2022) and before that, Editor-in-Chief of *South African Journal of Libraries and Information Science* (2002–2008). He has received research awards including NRF [RSA] established researcher rating (until 2028). Some of his research publications can be accessed at <https://scholar.google.com/citations?user=OJHFQG0AAAJ&hl=en>.

Omwoyo Bosire Onyancha Ph.D., is a Research Professor at the Department of Information Science, University of South Africa. He holds a Ph.D. in Library and Information Science and is a C2 National Research Foundation (SA)-rated researcher. His areas of research interest include Informetrics and Scientometrics, Information and Knowledge

Management, Science Communication, and Knowledge Mobilization. Professor Onyancha has explored these areas of research interest in order to advance the academic and societal understanding of how information and knowledge are created, disseminated, and utilized in various contexts. Furthermore, his research has provided insights into the impact of information and communication technologies in information processing and use, the role of metadata in information retrieval, and the importance of knowledge management in organizational performance. Some of his research can be accessed at: https://www.researchgate.net/profile/Omwoyo_Onyancha/contributions.

Aderonke Olaitan Adesina Ph.D., is an academic, researcher, author, and resourceful educational consultant with a background in the physical and social sciences. She has garnered work experience in the health, education, and consulting sectors over the last 25 years. Her passion lies in empowering young people through academics and life skills; a passion that led her to undertake a master's degree in Career Development at Nottingham Trent University, UK, to enable her to enhance her career planning, development, and counseling skills for teenagers, and adults in and out of schools. She earned her bachelor's and master's degrees in physics and information science, respectively, from the University of Ibadan, Nigeria, and her doctoral degree from the University of Zululand, South Africa. Aderonke is a member of the Chartered Institute of Personnel Management, Nigeria (CIPMN) and the Professional Editor's Guild of South Africa, both at the Associate level. She is a professional career practitioner at the Career Development Institute (CDI), UK. She is currently the Postgraduate and International Students Employability Project Officer at Nottingham Trent University, Nottingham, UK. Her research and teaching interests include information management, information systems, knowledge management, and enhancing the employability of individuals. Her research publications can be accessed at <https://scholar.google.com/citations?user=9T-V1aUAAAJ&hl=en>.

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Diffusion of Innovations: How Adoption of New Technology Spreads in Society

Blessing Mbatha

Abstract

This chapter sought to explore and explicate what the Diffusion of Innovations Theory is about. In addition, the chapter discusses the characteristics of innovators, the five-step process that an individual goes through when adopting a new idea or product, five adopter categories, the relevance of the theory to the LIS field, and concludes with the criticism of the theory. It cannot be denied that human beings do not routinely adopt new ideas or products. They make a conscious decision of whether to adopt or not. The Diffusion of Innovations theory outlines five characteristics that determine people's adoption of a new idea or innovation, namely: relative advantage; compatibility; complexity; trialability; and observability. This theory is used to explain how an idea or object is spread and adopted by many different individuals, be it in an organizational or societal context. The chapter presents the basic characteristics of individuals in a population and places them in one of the five adopter categories to determine the most effective way to appeal to that specific audience. Each category explains how a group of individuals assesses a new idea or technology and provides a five-step process that an individual goes through when adopting something new, namely: awareness, interest, evaluation, trial and adoption. Moreover, the chapter discusses how the Diffusion of Innovations theory describes the pattern and speed at which new ideas, practices, or products spread through a population. Thus, it groups individuals into five categories of how they adopt new ideas or technology, namely: innovators, early adopters, early majority, late majority, and laggards. The chapter also argues that the Diffusion of Innovations theory is relevant to the LIS field. It further argues that in general, the LIS

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field has adopted numerous innovations to automate a wide range of administrative and technical processes, build databases, and networks and provide better services to library users. Therefore, the diffusion and adoption of technology have become imperative for the efficient management of modern libraries and LIS as a field in general. The chapter concludes with a criticism of the theory.

1 Introduction

This chapter seeks to explore and explicate what the Diffusion of Innovations Theory is about. In addition, it discusses the characteristics of innovators, the five-step process that an individual goes through when adopting a new idea or product, the five adopter categories, the relevance of the theory to the LIS field, and concludes with the criticism of the theory. The Diffusion of Innovations theory is a well-known enduring social science theory coined by Rogers in 1962, a professor of communication studies, who popularized it in his well-known book: "Diffusion of Innovations". This theory attempts to explain the adoption of new ideas or technologies in organizational and societal contexts. In addition, it seeks to elucidate how and why new ideas and technologies spread among people, and at what rate of speed they are adopted. In other words, this theory is used to explain how an idea or object is spread and adopted by many people. It is important to note that with this theory, Rogers was more interested in evaluating the basic characteristics of people in a population and placing them in one of the five adopter categories to determine the most effective way to appeal to that specific audience (Rogers, 1962). Each category explains how a group of people views a new idea, behavior or product and provides a five-step process that everyone goes through when adopting something new, namely: awareness, interest, evaluation, trial, and adoption. Given, innovations are never adopted all at once. This is because as human beings we are different, have different experiences, and thus view things differently. Therefore, there is no escaping the fact that some people adopt innovations as soon as they become available, while some tend to adopt them at a later stage. This has been observed in many organizations and communities across the globe. The observation is that sometimes it can take a very long time for new ideas and products to become ubiquitous. This is attributed to the fact that each social system has its response. Therefore, the Diffusion of Innovations theory was developed to explain this phenomenon. Rogers argues that diffusion is the process by which an innovation is communicated over time among the participants in a social system. The origins of the Diffusion of Innovations theory are varied and span multiple disciplines. Rogers proposes that five main elements influence the spread of a new idea: the innovation itself, adopters, communication channels, time, and a social system. However, this chapter discusses only the characteristics of innovators, the five-step process that an individual goes through when adopting a new idea or product, and the five adopter categories.

2 What is an Innovation?

One cannot talk about the Diffusion of Innovations theory without talking about innovation just in general terms. Thus, is it important to start by defining the term “innovation”? Put rather loosely, an innovation can best be described as “an idea, practice, or object” (Rogers, 1962, 2004). It is perceived as new by an individual, group, or organization. However, it does not necessarily have to be “new” in the true sense of the word. In other words, innovation can refer to something new, such as an invention, or the practice of developing and introducing new things (Call & Herber, 2022). Innovation is often a new product, but it can also be a new way of doing something or even a new way of thinking. It is important to note that the purpose of innovation is to come up with new ideas and technologies that increase productivity and generate greater output and value with the same input (Rogers, 1962). There are numerous benefits of innovations, for instance, it enables problem-solving and provides creative insight that allows people to look at things from a different perspective, regardless of whether one is developing a new product, refreshing strategy, or finding an original way to stay ahead of the competition (Bhatti et al., 2021; Rogers, 1962; Rogers et al., 2014).

3 Five Characteristics of Innovations

Given, individuals do not automatically adopt new products, they make a conscious decision of whether to use a particular one. That is, their decision to adopt an innovation is deliberate. An innovation’s characteristics influence its chances for adoption. There are five main characteristics of innovations that determine how innovation will be responded to by a potential end-user (Bhatti et al., 2021; Rogers, 1962; Rogers et al., 2014). These include relative advantage; compatibility; complexity; trialability; and observability as discussed below.

3.1 Relative Advantage

This refers to the degree to which an innovation is seen as better than the idea, program, or product it replaces (Rogers, 1962). In other words, relative advantage has to do with the degree to which a new product is superior compared to an existing one. It can also be described as a major determinant of the rate of adoption of a new product. In this chapter, the relative advantage refers to the degree to which using a particular technology is perceived as being better in terms of enhancing job performance than using its preceding/competing technologies. Rogers’ theory purports that innovations that have a clear, unambiguous advantage over the previous approach will be more easily adopted and implemented. Thus, numerous scholars argue that if a potential user sees no relative

advantage in using the innovation, it is most likely not to be adopted (Greenhalgh et al., 2004; Ali et al., 2019).

Relative advantage measures how improved an innovation is over a competing option or the previous generation of a product. Potential users need to see how innovation improves their current situation. Improvements can be in one or many of these areas: better service, consolidation of multiple functions into one tool, decreased need for supplies and equipment, empowerment of users, improved interface, increased customizability, increased longevity, increased productivity, reduced user effort, reduced environmental impact, saving of money, saving of space or storage, saving of time, and so on (Greenhalgh et al., 2004; Ali et al., 2019). For example, in the 1980s and early 90s, computer word-processing programs such as WordStar and WordPerfect demonstrated relative advantage over existing products. Many organizations were using typewriters, which required a lot of space, performed only one function and required servicing, supplies and parts regularly. As computers evolved and became more prevalent, WordStar and WordPerfect freed users from typewriters. The relative advantage was quite palpable. The word-processing programs did not require any additional physical space aside from the personal computer, which already did several other office tasks, namely: they reduced the need for ink and correction tape; documents could be easily edited before printing, and files could be saved and transported for editing on other computers using floppy disks. Soon, typewriters were being phased out in many organizations and replaced with these computer word-processing programs.

3.2 Compatibility

This refers to how consistent the innovation is with the values, experiences, and needs of the potential adopters or consumers (Rogers, 1995). It belongs to the product characteristics that influence the adoption rate because consumers will only slowly start adopting a product if it is not compatible with their mindset. Numerous studies suggest that the more compatible the innovation is, the greater the likelihood of that particular innovation being adopted (Greenhalgh et al., 2004; Scott et al., 2008; Bharadwaj & Deka, 2021). Compatibility refers to the level of compatibility that an innovation has with individuals as they assimilate it into their lives. Potential adopters need to know that the innovation will be compatible with their life and lifestyle. If innovation requires a huge lifestyle change or if the user must acquire additional products to make the innovation work, then it is more likely to fail. Innovations meet with the greatest success when users can seamlessly adopt them—when they replace an existing product or idea, for the better. Apple's iPad is an example of an innovation that had a high level of compatibility with potential users' lives when released. Many users were able to replace products they were currently using when the iPad was released, such as smartphones and laptop computers to check their email, read books, magazines and blogs and view videos online.

3.3 Complexity

This refers to the degree to which an innovation is perceived as difficult to understand and use (Rogers, 1995). Rogers argues that innovations may be categorized on a complexity-simplicity continuum with a qualification that the meaning of the innovation may not be clearly understood by potential adopters. For instance, when key players perceive innovations as being easy to use, there is a greater likelihood that such innovations will be more easily adopted (Greenhalgh et al., 2004; Scott et al., 2008; Vargo et al., 2020). Complexity or simplicity refers to how difficult it is for adopters to learn to use an innovation. In other words, complexity slows down the gears of progress. The more complex an innovation, the more difficult it will be for potential adopters to incorporate it into their lives. Potential adopters do not usually budget much time for learning to use an innovation. A good example, in this case, is Netflix. In 2001, Netflix users paid a monthly fee to receive mail-order digital video disk rentals. Netflix took a very simple concept and made it even simpler. This is a common characteristic of successful innovation: take something that others already do and do it even better. The concept of renting video was not new. However, Netflix simplified the process in the sense that users would create a queue of videos online, which would ship to them in their preferred order, and then they would return the videos once they had watched them. Later, Netflix took simplicity a step further by making behavior-based recommendations to users. The system would recommend content based on a user's ratings of titles they had watched. This positioned Netflix as an expert in the eyes of users. Netflix not only provided content but curated and recommended user-specific content, without the user having to leave their home or pay an additional cost.

3.4 Trial-Ability

This refers to the extent to which the innovation can be tested or experimented with before a commitment to adoption is made (Rogers, 1995). In other words, trialability can best be described as the degree to which an innovation may be experimented with on a limited basis. It is worth noting that since innovations require investing time, energy and resources, innovations that can be tried before being fully implemented are more readily adopted (Greenhalgh et al., 2004; Scott et al., 2008; Sartipi, 2020). Trialability is the ease with which customers can try a new product or service. This is quite important for innovative products that have to be experienced to see their value. Any product or service that could wow customers benefits greatly from trialability. This can include improvements in quality that sound like exaggerations when put into words. Trialability is also important when customers need to integrate a product or service with other things such as a chair that need to fit into a space or suit a room. There is a variety of common types of trialability, some are called trial sizes, these are small packages of new products that are